

BRICK ARCH CULVERT OVER MASTER STREET

Pennsylvania Historic Bridges Recording Project

Spanning dirt slope of Master St. at 33rd St. (U.S. Rt. 13)

Philadelphia

Philadelphia County

Pennsylvania

HAER No. PA-463

HAER  
PA  
SI-PHILA,  
704-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD

National Park Service

1849 C Street, NW

Washington, DC 20240

HISTORIC AMERICAN ENGINEERING RECORD  
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Location: Spanning dirt slope of Master Street at 33rd Street (U.S. Route 13), Philadelphia, Philadelphia County, Pennsylvania.

USGS Quadrangle: Philadelphia, Pennsylvania-New Jersey (1967, photorevised 1985).

UTM Coordinates: 18/483800/4425180

Dates of Construction: 1901-02.

Designer: Philadelphia Department of Public Works, George S. Webster, chief engineer; George M. Mills, assistant engineer.

Builder: Henderson and Company, Ltd.

Present Owner: Pennsylvania Department of Transportation.

Present Use: Vehicular bridge.

Significance: This single-span skew arch culvert features brick ribs, semi-coursed squared stone masonry spandrel walls, and ashlar voussoirs. It was built to provide access to important water mains and is skewed due to a bend in Philadelphia's 33rd Street, which runs above it. The culvert is an integral part of a large retaining wall and abutment complex that comprises two bridges along 33rd Street. The bridges were erected to offer convenient access between North and West Philadelphia, and to provide a decorative gateway to the eastern edge of Fairmount Park. The brick arch culvert over Master Street was placed in the National Register of Historic Places in 1988.

Historian: J. Philip Gruen, August 1997.

Project Information: This bridge was documented by the Historic American Engineering Record (HAER) as part of the Pennsylvania Historic Bridges Recording Project - I, co-sponsored by the Pennsylvania Department of Transportation (PennDOT) and the Pennsylvania Historical and Museum Commission during the summer of 1997. The project was supervised by Eric DeLony, Chief of HAER.

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Philadelphia had long established itself as one of America's leading commercial and industrial centers by the turn of the twentieth century. It had been the nation's second-largest city for much of the nineteenth century, and its population had increased from 847,170 in 1880 to 1,293,647 in 1900.<sup>1</sup> There were no signs of abatement in its growth.

The growing population made it increasingly necessary to update a somewhat outdated city infrastructure with improvements in streets, sewers, public transportation, and bridges. Philadelphia's newly-formed Department of Public Works desired to provide these improvements while placing them within a contemporary ideology of urban aesthetic enhancement. These ideas were in keeping with civic beautification efforts being adopted by cities nationwide at the turn of the twentieth century.

Between 1894 and 1905, one of the major urban projects undertaken by Philadelphia's Department of Public Works was the construction of two bridges spanning two proximate sets of railroad tracks — one for the Philadelphia and Reading Railroad and the other for the Philadelphia Connecting Railway — along 33rd Street in the near-northern section of the city. The bridges were to connect 33rd Street with Girard Avenue along the eastern edge of Fairmount Park, thereby providing convenient vehicular access between a portion of North Philadelphia and both West Philadelphia and downtown. The bridges' highly visible semi-coursed squared stone masonry abutments and retaining walls were to heighten the appearance of Fairmount Park's eastern edge.

The bridges were built in three stages over an eleven-year period, the middle stage of which (1901-02) included the construction of a single, 41'-2" span, skewed arch culvert with interior brick ribs over Master Street.<sup>2</sup> Its construction permitted city workers to easily access underground water pipes that were part of Philadelphia's water supply and crucial for a city fighting the devastating effects of typhoid fever.<sup>3</sup> The brick arch culvert was completed in 1902 by the Philadelphia Department of Public Works, and its design fell under the supervision of

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<sup>1</sup> Figures from Nathaniel Bart and Wallace E. Davies, "The Iron Age: 1876-1905," in Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton and Company, 1982), 488.

<sup>2</sup> There is some discrepancy in the literature regarding the physical description of this structure. Original plans and annual reports from the Philadelphia Department of Public Works refer to it simply as a "brick arch." In their nomination of the structure to the National Register, the Pennsylvania Department of Transportation (PennDOT) and the Pennsylvania Historical and Museum Commission classified it as a "stone arch bridge." However, the notion of the structure simply as an "arch" gives no indication as to its function, and the structure is not a singular bridge but part of the considerably larger 33rd Street bridge complex. In 1994, a PennDOT bridge inspection report called the structure a "brick arch culvert," which provides a more accurate description of its appearance and function, for culverts generally provide access to water mains and other drainage systems. It will be referred to as a "culvert" throughout this report.

<sup>3</sup> The city was in the midst of a typhoid epidemic at the turn of the century, and even in 1906, 1,063 city residents were stricken with the fever. It was not until the 1908 opening of the Torresdale filtration plant (at the time, the largest of its kind in the world) that the city began to effectively combat the disease. See Bart and Davies, "The Iron Age," 526.

Chief Engineer George S. Webster and Assistant Engineer George M. Mills. The culvert and its features are this report's principal concern; however, the culvert's story is incomplete without some understanding of its purpose as part of the 33rd Street bridge complex and their place in the context of Philadelphia's public works at the turn of the twentieth century.

### Context and Background

By 1900, Philadelphia's public works were in need of a major overhaul. A burgeoning population (caused, in part, by waves of Eastern European, Irish, Italian, and African immigration) pushed city services and civic infrastructure to the limit, exposing inadequacies, provoking criticism, and necessitating repairs.<sup>4</sup> Despite progressive improvements that had transformed Philadelphia into an industrial and technological powerhouse in the post-Civil War years, including the expansion and electrification of the city's trolley and subway lines, the city still awaited a "system of streets" to facilitate vehicular access and to allow for future growth. Furthermore, this system was to combine accessibility with civic beauty.<sup>5</sup>

Although the 33rd Street bridges project began before the turn of the century, it was infused with the spirit of civic enhancement that arguably emerged following the 1893 World's Columbian Exposition in Chicago. In Philadelphia, however, the moves toward civic enhancement may have been more directly influenced by ideas stemming from the 1876 Centennial Exposition, held in a section of Fairmount Park across the Schuylkill River from the bridges' site. As early as 1884, in fact, city surveyors drew up a proposal for a new, contoured "drive" to span railroad tracks and connect 33rd Street with Girard Avenue.<sup>6</sup> The 33rd Street bridges eventually comprised part of this contoured drive.

Twenty years later, however, a 1904 Public Works Department annual report was still pushing for the completion of these bridges. They were to provide a "convenient and beautiful drive" with "easy grades" between North Philadelphia and the southern section of West Philadelphia generally, and between a populated sector of North Philadelphia and the Lemon Hill area of Fairmount Park more specifically. This rhetoric largely echoed that of an 1896 annual report, where the department explained that the construction of the bridges will "complete the

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<sup>4</sup> Bart and Davies, "The Iron Age," 487-96.

<sup>5</sup> See, for example, Philadelphia Department of Public Works, *Second Annual Message of John Weaver, Mayor of the City of Philadelphia, with the Annual Reports of Peter E. Costello, Director of the Department of Public Works and of the Chief of the Bureau of Surveys for the Year Ending December 31, 1904* (Philadelphia: Dunlap Printing Company, 1905), 94, 131.

<sup>6</sup> Philadelphia Department of Surveys, "Plan for Drive Connecting Thirty-Third Street with Girard Avenue, Passing over the Reading Railroad and the Connecting Railroad," February 1884, drawing No. 7084, compartment No. 16.

eastern boundary of Fairmount Park, furnishing a beautiful approach to the entrances north of Girard Avenue."<sup>7</sup>

The relative importance the city accorded the 33rd Street bridges is played out in the annual reports of the Philadelphia Department of Public Works before and during their erection. In 1894, prior to the beginning of construction, the bridges topped a list of twenty-six "urgent bridges" whose erection or completion was required to "properly develop" the areas of the city in which they were located.<sup>8</sup> In 1904, the 33rd Street bridges remained atop the list, which then included twenty-five bridges.<sup>9</sup> Over the ten-year period, the 33rd Street bridges project required the highest appropriation of city funds allocated for bridge construction, and photographs of the construction were periodically featured in the reports.

### Stage One (1895-96)

Despite their apparent urgency, in 1894, when the bridges' construction was authorized by a city council ordinance, there was only enough money to grade the land, remove a stable, and build the masonry substructure (abutments, wing walls, and piers, with the exception of the north abutment over the tracks of the Philadelphia and Reading Railroad). The contract was given to Mills Construction Company for its low bid of \$98,000.00. The company was given five months to complete the work.

This first stage of construction began in early August 1895 and was finished by 29 May 1896, at a cost of \$92,504.63 — nearly \$5,500.00 under budget but well after the agreed-upon completion date. This delay, for reasons unknown, would not be the only delay during the bridges' construction. When work began in the mid-1890s, nobody could have predicted that the bridges would still be unfinished eleven years later.

The delays were probably caused by a lack of adequate funding. With so many bridges and other major public works needed in late nineteenth-century Philadelphia, it is likely that the monies had to be distributed fairly among a number of different projects. Yet the 33rd Street bridges remained a priority as far as the Department of Public Works was concerned. In December 1896, shortly after Mills Construction Company had fulfilled its contract for the

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<sup>7</sup> *Second Annual Message of Charles F. Warwick, Mayor of the City of Philadelphia, with Annual Report of Thomas M. Thompson, Director of the Department of Public Works and of the Bureau of Surveys for the Year Ending December 31, 1896* (Philadelphia: Dunlap Printing Company, 1897), 94.

<sup>8</sup> *Fourth Annual Message of Edwin S. Stuart, Mayor of the City of Philadelphia, with Annual Report of James H. Windrim, Director of the Department of Public Works and of the Bureau of Street Cleaning for the Year Ending December 31, 1894* (Philadelphia: Dunlap Printing Company, 1895), 147.

<sup>9</sup> Philadelphia Department of Public Works, *Second Annual Message of John Weaver*, 136. Most of the bridges on the 1904 list appeared on the 1894 list. Like the 33rd Street bridges, the other bridges either awaited completion or funding.

substructure, the department noted that if funding became available, the completion of the bridges was of the "first importance."<sup>10</sup>

### Stage Two and the Brick Arch Culvert (1901-02)

The funding delay may have been exacerbated by the fact that the second stage required slightly more work and a larger allocation of funds — \$125,000.00 — than the first. This money appeared in 1901, six years after completion of the first stage. The bulk of the work for the project's second stage included the completion of the north abutment over the Philadelphia and Reading Railroad tracks, the erection of a massive semi-coursed squared stone masonry retaining wall connecting the two bridges, drainage work, and the construction of a brick arch culvert along the line of Master Street. While George S. Webster continued to oversee the construction, his assistant George M. Mills was more closely involved in the construction of the brick arch culvert.

Henderson and Company, Ltd., offered the low bid of \$92,380.00 for this work, agreeing to fulfill the contract eight months from 13 May 1901. The prolific Henderson and Company was also involved in eight other Philadelphia bridge projects in 1901, comprising the lion's share of contracting work for city bridge construction that year. When Henderson and Company completed the work, the city's total cost came to \$131,542.80. The completion of the retaining wall fused the two bridges into one, and the project awaited only an appropriation of funds for the superstructure before it could be opened to vehicular traffic.

Begun after May 1901, the culvert was mostly finished by the end of the year, but not considered officially complete until Henderson and Company had finished the retaining wall and other work to fulfill the contract on 29 December 1902. A photograph taken in 1901 shows the finished arch next to the still-unfinished retaining wall.<sup>11</sup> As built, the single-span arch culvert is 99'-7-1/8" long from center to center of arch face rings and 41'-2" wide from face to face of abutments. The semi-circular arches have a radius of 21'-7-9/16", but are only 15 feet high at the western end because of the land's upward slope from east to west.

While the brick arch culvert was neither the most expensive nor most time-consuming aspect of the bridges' construction, it nevertheless stands out as a carefully-executed and aesthetically intriguing piece of work for its rather mundane yet vital function: providing access to the three water mains running underneath it. The culvert was built exclusively to provide access to "important water mains," according to a 1901 Department of Public Works annual

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<sup>10</sup> *Second Annual Message of Charles F. Warwick, Mayor of the City of Philadelphia, with Annual Report of Thomas M. Thompson, Director of the Department of Public Works and of the Bureau of Surveys for the Year Ending December 31, 1896* (Philadelphia: Dunlap Printing Company, 1897), 94.

<sup>11</sup> Philadelphia City Archives, "Surcharged Wall and Master Street, 1901," *33rd Street Bridge*, photographic collection, folder 1970, No. 1086D.

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report.<sup>12</sup> The need for access to these pipes was realized at least as early as 1895, when a general plan for the bridges suggested a brick arch over the pipes.<sup>13</sup>

Although original plans referred to the culvert as the "Brick Arch Over Master Street," it was not built to span a westward continuation of the street, which curves to the south just before the culvert site and terminates at the Philadelphia and Reading Railroad tracks. That the culvert could be said to span Master Street is only because it is on the line of Master Street; the culvert spans only a dirt slope that was never intended to be used for vehicular traffic. Because Master Street (which is well below the grade of 33rd Street) today ends nearly fifty yards to the east, access to the culvert is difficult.

The culvert is unusual because of its skewed orientation and its brick arch rings, which rest on a stone foundation. Bridges made of stone or brick were not uncommon in Pennsylvania or Philadelphia by 1901. Indeed, a number of stone arch bridges were constructed in southeastern Pennsylvania during the eighteenth and nineteenth centuries. The oldest extant bridge in America is a stone arch bridge constructed in 1697 over Pennypack Creek in the Holmesburg area of North Philadelphia.<sup>14</sup> Most of the old arch bridges, however, were built in a "right" orientation (where the axis of the arch is perpendicular to the bridge's axis); considerably more rare was a "skew" orientation (where the arch is at an oblique angle to the bridge's axis).

The culvert is built on a skew presumably because the 1884 plan for the 33rd Street curving "drive," as it approached the Philadelphia and Reading Railroad tracks and Girard Avenue from the north, meant that the bridge would cross the water mains at an oblique angle. It is puzzling why the structure features an interior ring made of twenty-eight rows of bricks, thus combining brick and stone. One possible explanation is the high cost of stone. It may be the only documented Pennsylvania example of a skew arch bridge or culvert with an interior ring of bricks.

In addition to combining different materials, the engineers varied the treatment of the stone. Each of the 2'-6"-wide brick ribs rest upon single rough skewback stones which, in turn, rest upon a semi-coursed rubble stone foundation. Because of the upward slope of the ground from east to west, this foundation is five layers thick on the eastern edge and only one layer thick on the west. The spandrel walls and wing walls are composed of semi-coursed squared stones, while the twenty-seven evenly-spaced voussoirs (including the keystone) are squared ashlar blocks. The culvert is topped by a parapet of smoothed ashlar. It is unclear why this

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<sup>12</sup> Philadelphia Department of Public Works, *Third Annual Message of Samuel H. Ashbridge, Mayor of the City of Philadelphia, with the Annual Reports of William C. Haddock, Director of the Department of Public Works and of the Bureau of Surveys for the Year Ending December 31, 1901* (Philadelphia: Dunlap Printing Company, 1902), 107.

<sup>13</sup> Philadelphia Department of Public Works, "General Plan of Bridges on the Line of 33rd Street over Phila. & Reading R.R. & Connecting R'w'y, Sheet 1," 1895, drawing.

<sup>14</sup> See U.S. Department of the Interior, *Historic American Engineering Record* (HAER) No. PA-465, "Pennypack Creek Bridge," 1997, Prints and Photographs Division, Library of Congress, Washington, D.C.

architectural variation exists within such a small structure, considering its scale relative to the entire bridge complex and the fact that it was not constructed for public use as an underpass.

### **Stage Three (1904-05)**

The completion of the brick arch culvert and the retaining wall in 1902 meant that only the superstructure awaited completion before the bridges could be opened to traffic. As before, however, the Department of Public Works had to wait for an appropriation of city funds before construction could begin. A \$1 million appropriation was granted by an ordinance approved on 11 August 1904, and \$500,000.00 was apportioned for bridge work throughout the city. Over one-fifth of this amount — \$110,000.00 — was allocated for the superstructure of the 33rd Street bridges. The Millard and McGraw Construction Company (employed at the time by the Department of Public Works to build the Tioga Tunnel under the Philadelphia and Reading Railway), offered a low bid of \$77,000.00 and was presented with a contract on 25 October 1904. The company was given seven months to complete the project, and while it finished on time, it came in \$587.00 over budget. Grading for the superstructure was provided by the State Bureau of Highways without cost to the city.

The superstructure provided the bridges with 70'-0"-wide steel plate-girder decks, a roadway 46'-0" wide between curbs, and 12'-0"-wide sidewalks. Part of the superstructure also included a decorative 4'-0"-high wrought-iron railing, a section of which was designed specifically for the brick arch culvert. The railing also featured two decorative 4'-10"-tall newel posts on each side. A drawing for the railing was approved on 14 August 1904, and the railing was built shortly thereafter.<sup>15</sup> Webster was still the chief engineer for the Department of Public Works during this final stage of the bridge's construction, but more of the day-to-day activities were now being handled by Henry H. Quimby, who had apparently taken over Mills' position as assistant engineer.

### **George S. Webster**

While different contracting companies and assistant engineers were employed during the different phases of construction, all phases were supervised by George S. Webster, who took over as chief engineer for the Bureau of Surveys in the Philadelphia Department of Public Works on 1 February 1893. A number of projects, both major and minor, were carried out under Webster's engineering supervision throughout his lengthy tenure with the Department of Public Works.<sup>16</sup>

Included among these projects was the 233'-0" clear-span Walnut Lane Bridge (1906-08) over Wissahickon Creek in Philadelphia's Fairmount Park, one of the nation's earliest open-

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<sup>15</sup> Philadelphia Department of Public Works, "33rd Street Bridges, Brick Arch over Master Street, Design for Wrought Iron Railing," 1 August 1904, drawing No. 8411, compartment No. 16.

<sup>16</sup> Webster remained chief engineer until 1915.



spandrel concrete arch bridges, and its longest for a time. Webster and Quimby also oversaw the initial design for the Henry Avenue (Wissahickon Memorial) Bridge in 1911, also in Fairmount Park, and Webster was retained as a consultant when Ralph Modjeski was put in charge of the final design some sixteen years later.<sup>17</sup> Webster also sat on the Delaware River Bridge Joint Commission and worked closely with Modjeski and Paul Cret in the execution of the Delaware River (now Benjamin Franklin) Bridge.

### Through the Years

The culvert has remained in decent condition over the years, and, with the exception of occasional repairs to the stone pointing and brick sealants, and the replacement of the original decorative wrought-iron railing with a steel one in 1994, it has not been significantly altered. Part of the original railing remained in 1986, when A. G. Lichtenstein and Associates made an inspection recommending, among other things, a new railing meeting current safety regulations.<sup>18</sup>

In 1994, a Pennsylvania Department of Transportation bridge inspection report noted spalled bricks, cracked stones, mortar cracking between the stones, and large areas of efflorescent staining.<sup>19</sup> At the time of this writing, heavy foliage blocked the culvert's western entrance and some graffiti marked the interior. Overall, however, the culvert — with its new steel railing — was in good condition. It was one of several historic bridges nominated to the National Register of Historic Places as part of a statewide multiple resource nomination in 1988, and the only brick arch structure nominated that was built on a skew.

Little known today, difficult to find, and only a small part of a much larger bridge complex that now spans tracks used by Amtrak, the Southeastern Pennsylvania Transportation Authority (SEPTA), and other railroad companies, the brick arch culvert under Philadelphia's 33rd Street retains much of its original appearance and is arguably the most aesthetically interesting part of the entire bridge complex. It continues to hold an important place as part of a public works project crucial to the advancement of Philadelphia's infrastructure, contributing to an overall effort at turn-of-the-century civic beautification.

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<sup>17</sup> [Editor's note: See HAER No. PA-464, "Henry Avenue Bridge," 1997, Prints and Photographs Division, Library of Congress, Washington, D.C.]

<sup>18</sup> Richard J. Slattery, "Bridge Inspection Report: 33rd Street over Master Street," (Langhorne, Pennsylvania: A. G. Lichtenstein and Associates, Inc., 10 June 1986), bridge inspection file, BMS No. 67-0013-0100-0851, PennDOT District 6-0, Saint Davids, Pennsylvania.

<sup>19</sup> Pennsylvania Department of Transportation, "Bridge Inspection Report," 18 April 1994, bridge inspection file, BMS No. 67-0013-0100-0851, PennDOT District 6-0, Saint Davids, Pennsylvania.

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